of Scientific and Industrial Research has apparently been accorded for the production of an English translation by Prof. Ryan of Hausding's "Handbook on the Winning and Utilisation of Peat."

As regards fuel alcohol, the position is summarised thus: "It is obvious that until an estimate has been made of the possible resources for the production of alcohol within the Empire, and until their probable amount and the cost of using them have been ascertained, it would be useless to embark upon research on any extended scale into methods of production or utilisation."

The report, under the head "Gas Standards," gives a summary of the steps taken by Sir George Beilby and the Board from the time they were asked to advise on the subject by the Board of Trade, which recognised the complete inapplicability to modern conditions of gas standards as they had existed before the war. Conferences were held with those interested in the matter in different ways, and at a final conference resolutions were put and adopted which were forwarded to the Board of Trade, and constitute a new and much more rational method of regulating gas supply by statute. The central principle is that the consumer shall be charged with the potential thermal units supplied to him in the gas. The permissible percentage of inert constituents is limited by another resolution, although, of course, the temptation to pull "inerts" into the gas is removed now that they have to be distributed at the same cost as combustibles, but have not to be paid for. The gas undertaking can decide on the calorific value of the gas it intends to deliver, a power which should open the way for extensive technical development of the industry, and allow of the realisation of economies which have hitherto been rendered impossible by useless and out-of-date restrictions. The refusal of Sir George Beilby and the Fuel Research Board to accept any restrictions in this regard, however pertinaciously and dogmatically they were put forward, unless they could be justified by some adequate reason, has exemplified in a striking way the advantage of referring a matter of this kind to a competent technical authority. The choice of a new standard is a new degree of freedom, but, the choice being made, the gas undertaking is required to adhere very closely to it. Recognition is here given to the valid principle that unsatisfactory performance of a gas-using appliance is far more likely to be due to variations from the standard than to any lowness (or highness) in the standard itself. It is recognised that if the standard is materially altered the burners in consumers' appliances may need alteration, and the gas undertaking has to make the adjustment. "The calorific value of the gas is to be continuously measured and recorded by a recording calorimeter of a standard type to be passed by the London Gas Referees," and by this means it is hoped that the control of gas quality can be made much more effective than it has been hitherto.

Sir George Beilby has had under observation for some time the Simmance recording gas calorimeter with apparently satisfactory results, but the strain will come when legal penalties are dependent upon the accuracy (or inaccuracy) of this or any other form of recording gas calorimeter. Presumably, however, the possibilities of error will receive full investigation, and the successful working of so promising a scheme for the regulation of public gas supply will not be endangered by the imposition of any rigid system of testing which is not one of fully proved trustworthiness.

Use of Sumner Lines in Navigation.[1]

By CAPT. T. H. TIZARD, C.B., F.R.S.

THE Sumner line as a means of aiding in the navigation of ships has been in use for certainly seventy years, and is one of the best methods of obtaining the position of a ship at sea, for by its means both latitude and longitude can be obtained simultaneously without difficulty, and it has certain other advantages. In obtaining both latitude and longitude simultaneously, observations of more than one heavenly body are required, and the Greenwich time must be known accurately, as well as the approximate latitude. The altitudes of two or more heavenly bodies can be observed at twilight, both morning and evening, when the weather is clear, the horizon distinctly visible, and the stars are yet to be seen before the sky is lit up by the sun. It is possible, too, even without using the Sumner line, to observe in daylight meridian altitudes of Venus or Jupiter if they cross the meridian at least two and a half hours before or after noon, and occasionally both sun and moon are available during the day. In northern latitudes the pole star is always available in clear weather, at twilight, for observations for latitude, and one or two other stars for longitude, but if neither the pole star nor a heavenly object near, or on, the meridian is available for obtaining the latitude, Sumner's method affords a means of doing so.

Sumner's method briefly is as follows: If a straight line be drawn from the centre of the earth to any heavenly body, at the spot where this line cuts the circumference of the earth, the altitude of that heavenly body will be 90°, which spot is named by Mr. Comstock the sub-polar point; a more appropriate name would be the zenith point—that is, the point on the earth's surface where the heavenly object observed would be in the zenith; and if circles be drawn on the earth's surface round this spot, with it as a centre, those circles are really circles of altitude of the heavenly body; so that when an observer takes an altitude of a heavenly body he is on a circle of altitude, and his position on that circle can be obtained by taking simultaneous altitudes of two heavenly bodies, or, in other words, of obtaining two circles of altitude which cut each other at a suitable angle, and the spot where they cut each other is the required position of the observer. The circles of altitude are of such a great radius that for short distances they are practically straight lines. There are two methods of obtaining the position of sections of these circles of altitude, or Sumner lines. In both it is necessary to know the exact Greenwich time, the approximate latitude, and the exact declination of the heavenly object. These are always available in a ship provided with a chronometer and a Nautical Almanac.

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[1] "The Sumner Line or Line of Position as an Aid to Navigation." By G. C. Comstock. Pp. vi+70. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1919.) Price 6s. net.

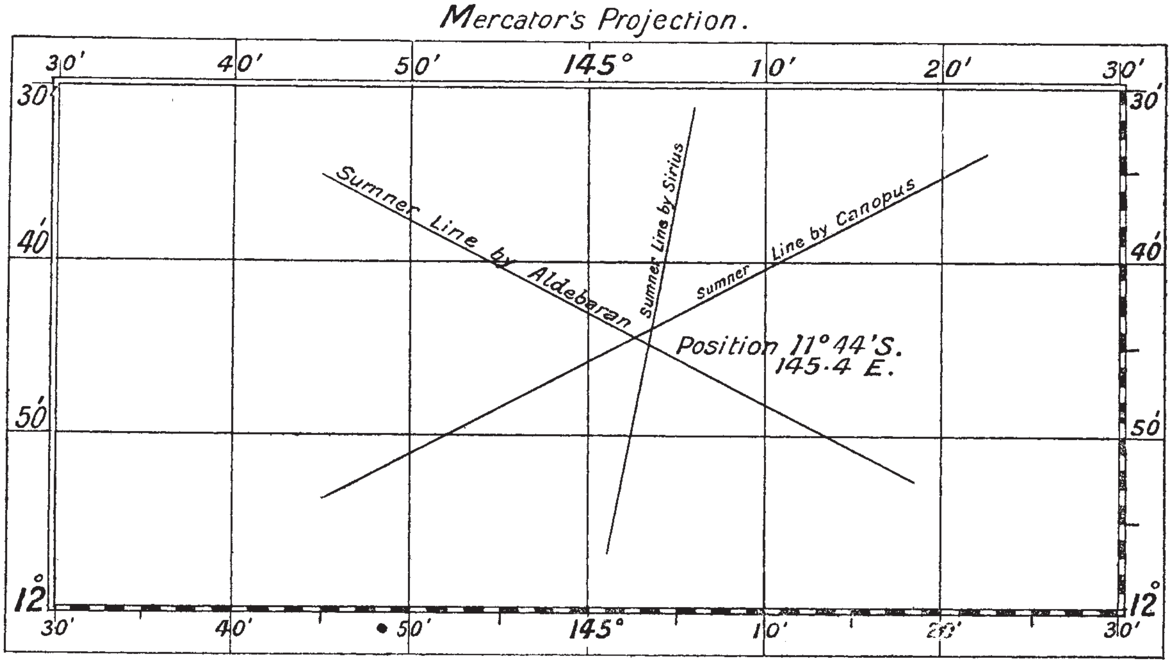
Mercator's Projection.

FIG. 1.

The first method is to assume two latitudes, one, say, 10 miles north, and the other 10 miles south, of the approximate position, and with each latitude, combined with the altitude and polar distance, to calculate the longitude, a process familiar to all navigators; then plot the two positions thus obtained and draw a line on the chart joining them, and the observer must be on that line. With observations of another heavenly body, and using the same latitudes, go through the same process, and the observer's position will be on the spot where the two lines cross each other. If it is very important to avoid error—as when sailing towards narrow channels through coral reefs, such, for instance, as the Raine Island passage through the Great Barrier Reef in Australia—observations of a third star can be taken, and the resulting Sumner line should coincide in cutting the other two lines in, or close to, the spot already determined.

The second method of obtaining the Sumner line is to use only one latitude, and to calculate the longitude and the azimuth, or true bearing, of the heavenly body; then, as the circle of altitude, or Sumner line, is at right angles to the true bearing, already calculated, by plotting the latitude and longitude and drawing lines at right angles to the true bearing, the position of the observer is where those lines cut each other.

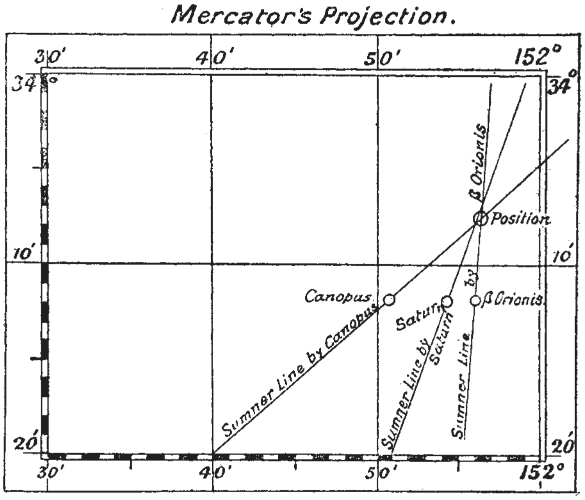
Mercator's Projection.

FIG. 2.

The following examples illustrate the methods:

(1) On August 30, 1874, when H.M.S. *Chal-*

lenger was making for the Raine Island passage, observations were taken at 5 a.m. of Aldebaran, Sirius, and Canopus, and the latitude was assumed to be 11° 40′ S. or 11° 50′ S. Using these latitudes, the position of the Sumner lines was found to be as shown in Fig. 1, and the position of the vessel to be 11° 44′ S., 145° 4′ E.

(2) On June 13, 1874, observations were taken at 6 a.m. (to fix the position of a deep-sea sounding) of β Orionis, Canopus, and Saturn, the latitude being assumed as 34° 12′ S., the resulting longitude by β Orionis being 151° 56′ E., and its azimuth S. 86° 26′ E., the Sumner line therefore running N. 3° 34′ E. and S. 3° 34′ W. The longitude by Canopus was 151° 50′ 45″ E., and its azimuth S. 39° 18′ E., its Sumner line running N. 50° 42′ E., S. 50° 42′ W.; the longitude by Saturn was 151° 54′ 15″ E., and its azimuth N. 73° W., and the Sumner line by it running N. 17° E., S. 17° W. These lines are shown in Fig. 2, and the position of the sounding was lat. 34° 8′ S., long. 151° 56′ E.

But the Sumner line has another advantage. When only one heavenly body is visible, and, therefore, the exact position of the observer cannot be obtained, if with an assumed latitude the longitude and azimuth be calculated, and the resulting Sumner line be plotted on the chart, if this line runs in the direction of the port, or point of land, towards which the ship is sailing, by steering along the Sumner line the vessel will reach her destination. For instance, if when sailing towards the English Channel an observation of the sun be obtained in the forenoon, when its azimuth, or true bearing, is somewhere between south and east, the Sumner line will be between east and north; and if this line runs towards the Lizard or some other known point, by steering along this Sumner line a good landfall may be obtained.

Obituary.

DR. F. A. TARLETON.

FRANCIS ALEXANDER TARLETON, who died on June 20, was born in Co. Monaghan in 1841. He was the youngest son of the late Rev. J. R. Tarleton, of the Established Church in Ireland, and received his earlier education from his father. At the age of sixteen he entered Trinity College, Dublin. He was in the same year as the late Sir Robert Ball, whom he defeated at the moderatorship examination in mathematics in 1861, taking also a junior moderatorship in logic and ethics. Elected to fellowship in 1866, and called to the Bar in 1868, he was for a time assistant to the professor of applied chemistry, and professor of natural philosophy from 1890 to 1901, when he was co-opted a senior fellow. From that time until a few days before his death he sat as an efficient member of the board of Trinity College. Dr. Tarleton held several college offices, including those of senior bursar, senior lecturer, and senior dean, the last being a sinecure—for its statutory duties have long since lapsed. As senior bursar he showed his qualities as a first-class financier. He was at one time president of the Royal Irish Academy, and a member of the Board of Irish Intermediate Education.

As professor of natural philosophy, Dr. Tarleton followed the traditions of his distinguished predecessors, Williamson, Townsend, and Jellett, in treating the subject from a strictly mathematical point of view. Although he had a considerable practical acquaintance with experimental science, he flatly ignored the judicial aphorisms of Francis Bacon, and, instead of treating mathematics as the handmaid of physics, he rather inverted the order, and almost succeeded in reducing hydrodynamics, elasticity, magnetism, and electricity to branches of pure mathematics.

The writer attended Dr. Tarleton's moderatorship and fellowship lectures about twenty years ago in hydrodynamics, elasticity, and the electromagnetic theory of light, and was struck with wonder at his extraordinary memory and accuracy. For two and a half hours he would write down long and intricate calculations without the aid of any notes. Sometimes a student at the end of an hour would ask to be allowed to leave in order to attend a lecture in experimental science or history or other subject, and Dr. Tarleton would say with a snarl and a grimace (covering a heart full of humour and humanism): "Waal, if you prefer that *abominable* subject to mathematics, you are welcome to leave, and we're glad to get rid of you."

The last time the writer spoke to him, Dr. Tarleton expressed his intense dislike of Einstein's theory of relativity. He held that the Newtonian and Kantian conceptions of space and time are good enough to explain all possible phenomena, if sufficient mathematical ingenuity is shown, and he placed relativism in the same category as Bolshevism.

Dr. Tarleton wrote the following papers:—"On the Solid of Revolution having a Given Volume which experiences the Least Resistance in Passing Through a Medium," "Chemical Equilibrium," "Deductions from MacCullagh's Lectures on Rotation," "The Foundations of the Science of Number," "Notes on Crystallography," "Geometrical Proofs of Some Properties of Conics," "The Harmonic Determinant," "Laplace's Coefficients," and "A Problem in Vortex Motion." His two books "Dynamics" (written in conjunction with Williamson) and "An Introduction to the Mathematical Theory of Attractions" are first-class text-books of their kind. The latter contains a chapter on Maxwell's electro-magnetic theory of light.

R. A. P. ROGERS.